# 1st International Summer Snowfall Workshop

## An Application Programming Interface for Synthetic Snowflake Particle Structure and Scattering Data

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# Outline

- **Motivations for Development**

- **Navigating the Interface from Registration to Data Acquisition**

- **Live Demo**

# Motivations for Development

**- Dr. Kwo-Sen Kuo's OpenSSP Database contains statistical data for over 9000 synthetic snowflakes and scattering information for each at 15 representative frequencies.**

**- Researchers only need segments of the data to test its usefulness and integrate it into models.**

**- The OpenSSP API and Query Builder enable the acquisition of targeted subsets of the database, both by particle size and family, and by binned particle size distribution.**

**- The Query Builder page also offers access to raw data archives and particle structure files.**

# Navigating the Interface

**The website is located at the following URL:**
**[https://storm.pps.eosdis.nasa.gov/storm/OpenSSP.jsp](https://storm.pps.eosdis.nasa.gov/storm/OpenSSP.jsp)**

Secure | https://storm.pps.eosdis.nasa.gov/storm/OpenSSP.jsp

National Aeronautics
and Space Administration

+ PPS Contacts
+ Related Links

**OpenSSP Query Builder**

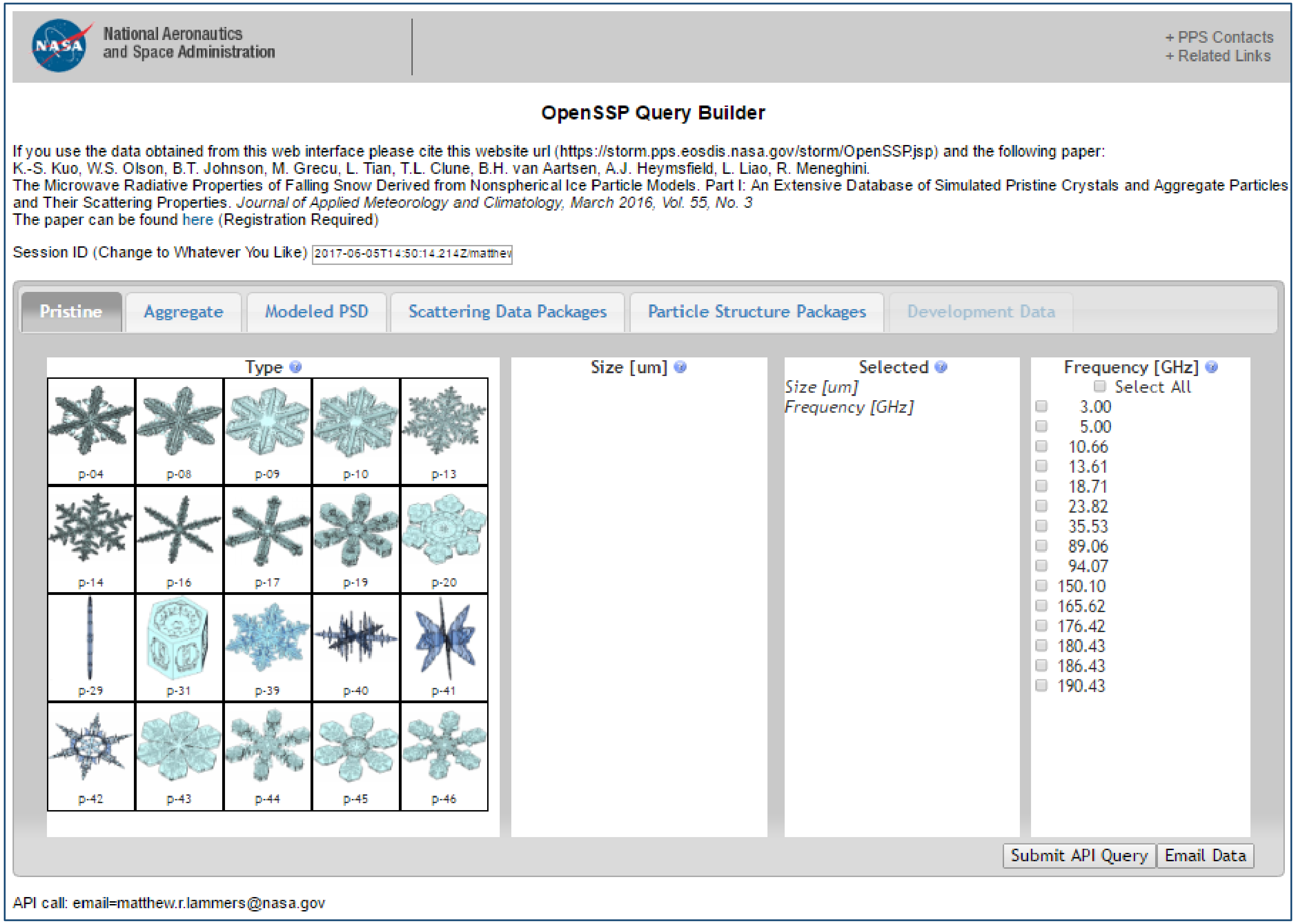
Registration Email: [ ] Submit Don't have a registered email? Register here!

If you use the data obtained from this web interface please cite this website url (https://storm.pps.eosdis.nasa.gov/storm/OpenSSP.jsp) and the following paper:
K.-S. Kuo, W.S. Olson, B.T. Johnson, M. Grecu, L. Tian, T.L. Clune, B.H. van Aartsen, A.J. Heymsfield, L. Liao, R. Meneghini.
The Microwave Radiative Properties of Falling Snow Derived from Nonspherical Ice Particle Models. Part I: An Extensive Database of Simulated Pristine Crystals and Aggregate Particles, and Their Scattering Properties. *Journal of Applied Meteorology and Climatology, March 2016, Vol. 55, No. 3*
The paper can be found here (Registration Required)

**Credits**
Lead Scientist: Kwo-Sen Kuo
Contributing Scientists: Ziad S. Haddad, William S. Olson, Simone Tanelli, John Kwiatkowski
Web Developer: Matt Lammers
Database Scientist: Noppasin Niamsuwan
**Version Information**
OpenSSP API Version 17.05.001
Version Notes

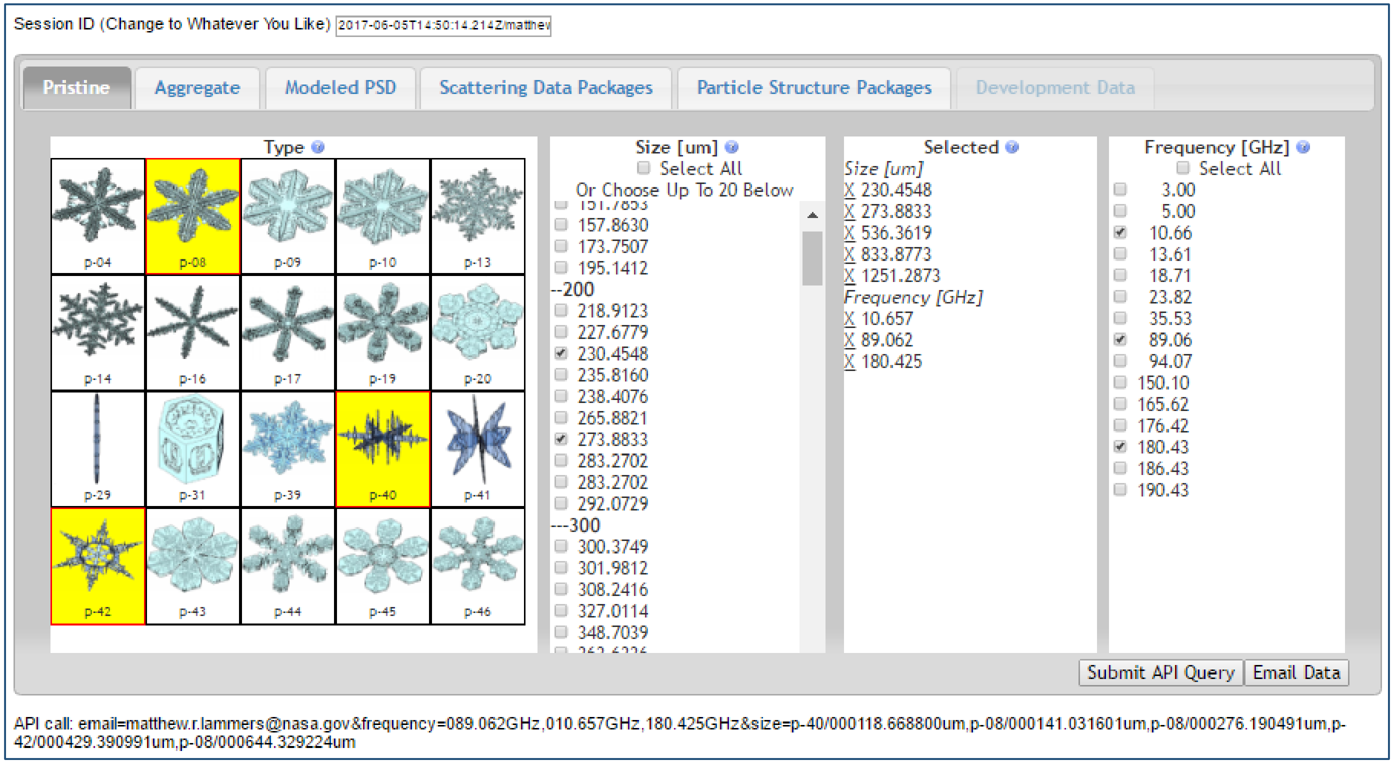
**Using the interface requires an email registered at [https://registration.pps.eosdis.nasa.gov](https://registration.pps.eosdis.nasa.gov). Once complete, entering the email and pressing "Submit" takes you to the Query Builder interface.**

# Navigating the Interface




**There are five available tabs upon inputting a registered email. The first three are for API queries, the last two for raw data.**

# Navigating the Interface




**In Pristine (or Aggregate):**

- **Select one or more types**
- **Select up to 20 discrete sizes (or all sizes) from the list**
- **Select one or more frequencies (or all).**
- **Press "Submit API Query" or "Email Data"**

# Navigating the Interface

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```
#OpenSSPAPI Version 17.05.001
#Email: matthew.r.lammers@nasa.gov
Frequency[GHz] Wvlngth[um] Shape KOI Size[um] D_max[um] rho_D_max[g/cm^3] Q_bk Q_ext Q_sca Q_abs g Volume[um^3] Prj_Area[um^2] Sfc_Area[um^2] r_eq_vol[um] r_eq_prj[um] r_eq_sfc[um] L_lx[um] L_ly[um] L_lz[um] rho_elps[g/cm^3] d_fractal
089.062 3368.5000 p-40 r20100916-40_0003000 230.454810 807.7747 0.02325176 1.1711E-4 0.0022887 0.0011317 0.001157 0.0541 7000000.0 92500.0 625000.0 118.6688 171.5915 223.0155 109.8419 306.8845 519.9065 0.0874115 3.0
089.062 3368.5000 p-08 r20100916-08_0001500 273.883369 406.20193 0.30693084 3.2291E-4 0.0044909 0.0028788 0.0016121 0.0189 1.175E7 40000.0 405000.0 141.0316 112.8379 179.524 61.61492 234.1522 249.1568 0.7153515 3.0
089.062 3368.5000 p-08 r20100916-08_0006000 536.361934 1250.9996 0.07891722 0.0041841 0.0521 0.0477 0.0044025 0.1046 8.825E7 147500.0 2970000.0 276.1905 216.6812 486.1533 84.61565 665.6495 681.9448 0.5028144 3.0
089.062 3368.5000 p-42 r20100916-42_0021500 833.877305 6450.194 0.0021635033 0.0044749 0.0490 0.0434 0.0055746 0.4738 3.31624992E8 717441.4 1.3495E7 429.391 477.8793 1036.291 131.0673 6170.292 6300.725 0.014242795 3.0
089.062 3368.5000 p-08 r20100916-08_0038000 1251.287353 4614.38 0.019966431 0.0249 0.4214 0.4101 0.0114 0.5223 1.12049997E9 849595.3 2.753E7 644.3292 520.0332 1480.124 127.6454 2737.038 2839.267 0.24720553 3.0
010.657 28150.0000 p-40 r20100916-40_0003000 230.454810 807.7747 0.02325176 3.0579E-8 1.1167E-5 2.5846E-7 1.0908E-5 9.5144E-4 7000000.0 92500.0 625000.0 118.6688 171.5915 223.0155 109.8419 306.8845 519.9065 0.0874115 3.0
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010.657 28150.0000 p-42 r20100916-42_0021500 833.877305 6450.194 0.0021635033 5.2507E-6 9.8754E-5 4.8842E-5 4.9912E-5 0.0345 3.31624992E8 717441.4 1.3495E7 429.391 477.8793 1036.291 131.0673 6170.292 6300.725 0.014242795 3.0
010.657 28150.0000 p-08 r20100916-08_0038000 1251.287353 4614.38 0.019966431 3.3731E-5 3.9276E-4 3.0658E-4 8.6178E-5 0.0205 1.12049997E9 849595.3 2.753E7 644.3292 520.0332 1480.124 127.6454 2737.038 2839.267 0.24720553 3.0
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180.425 1662.7000 p-08 r20100916-08_0001500 273.883369 406.20193 0.30693084 0.0048266 0.0562 0.0498 0.0063838 0.0740 1.175E7 40000.0 405000.0 141.0316 112.8379 179.524 61.61492 234.1522 249.1568 0.7153515 3.0
180.425 1662.7000 p-08 r20100916-08_0006000 536.361934 1250.9996 0.07891722 0.0239 0.5903 0.5711 0.0192 0.3534 8.825E7 147500.0 2970000.0 276.1905 216.6812 486.1533 84.61565 665.6495 681.9448 0.5028144 3.0
180.425 1662.7000 p-42 r20100916-42_0021500 833.877305 6450.194 0.0021635033 0.0698 0.3624 0.3408 0.0216 0.4670 3.31624992E8 717441.4 1.3495E7 429.391 477.8793 1036.291 131.0673 6170.292 6300.725 0.014242795 3.0
180.425 1662.7000 p-08 r20100916-08_0038000 1251.287353 4614.38 0.019966431 0.3574 2.6904 2.6430 0.0474 0.6627 1.12049997E9 849595.3 2.753E7 644.3292 520.0332 1480.124 127.6454 2737.038 2839.267 0.24720553 3.0
#Variable Explanations
#KOI: Kuo Original Identifier used when generating the synthetic snowflakes
#D_max: maximum dimension/diameter
#rho_D_max: snow density based on D_max, ice mass of the particle divided by the volume of a sphere with D_max as its diameter
#Q_bk: backscattering efficiency
#Q_ext: extinction efficiency
#Q_sca: scattering efficiency
#Q_abs: absorption efficiency
#g: asymmetry factor
#Prj_Area: orientation-averaged projection area of the particle
#Sfc_Area: surface area of the particle
#r_eq_vol: radius of a sphere having the same volume as the ice mass of the particle
#r_eq_prj: radius of a sphere having the same projection area as the orientation-averaged projection area of the particle
#r_eq_sfc: radius of a sphere having the same surface area as that of the particle
#L_lx: length of the shortest axis of a circumscribing ellipsoid of the particle that is parallel to the axis of maximum moment of inertia
#L_ly: length of the intermediate axis of a circumscribing ellipsoid perpendicular to both axes of the maximum and minimum moments of inertia
#L_lz: length of the longest axis of a circumscribing ellipsoid of the particle that is parallel to the axis of minimum moment of inertia
#rho_elps: snow density based on the circumscribing ellipsoid, ice mass of the particle divided by the volume of the circumscribing ellipsoid
```

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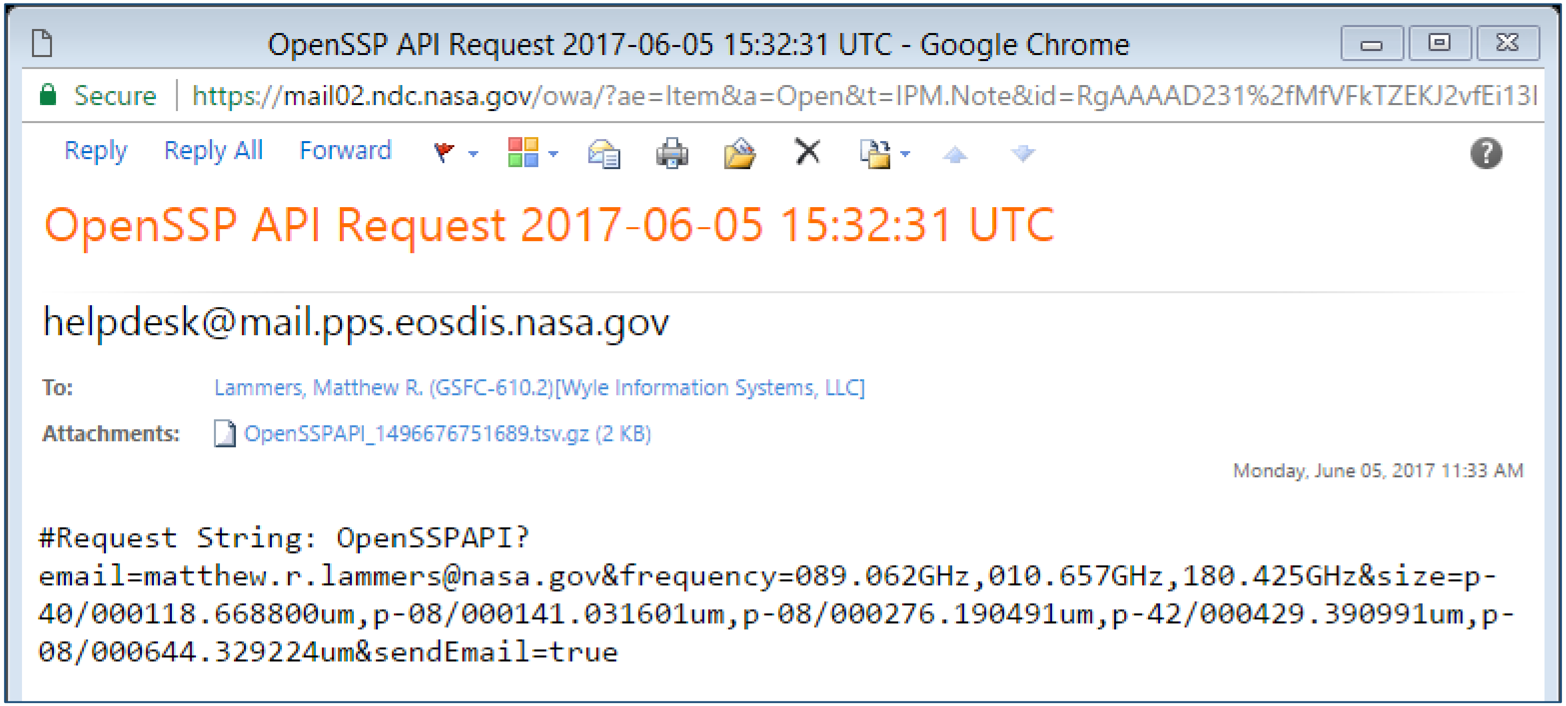
**Upon pressing the “Submit API Query” button, the API response will open up in a new tab. Variable explanations are listed below the data.**

# Navigating the Interface



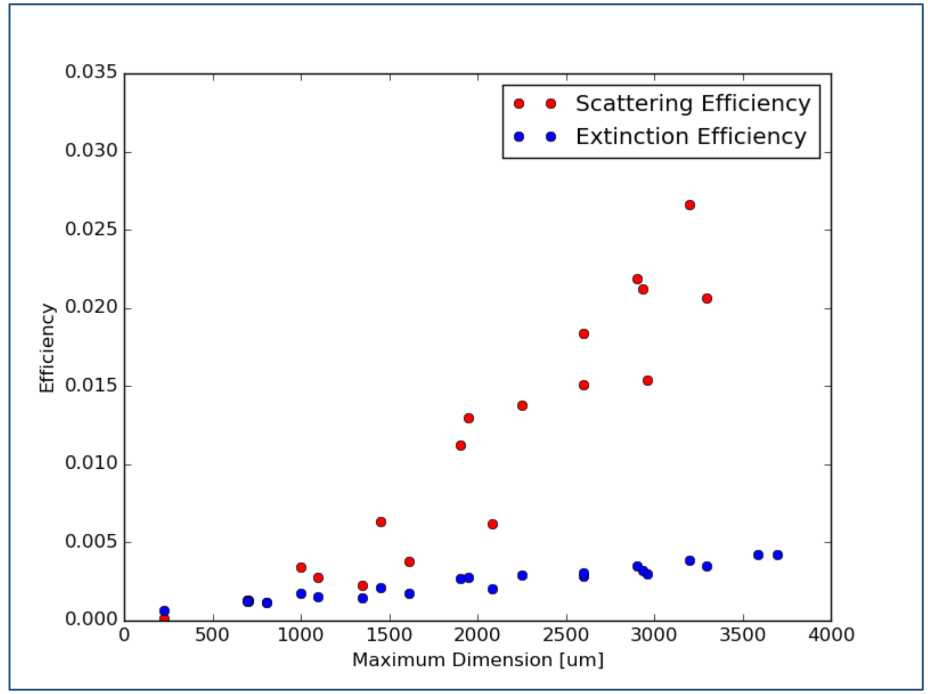

**If instead you press the "Email Data" button, an email is sent to the registered email address containing the query request string and an attached comma-separated value/tab-separated value file.**
**This can be extremely useful for large queries where waiting for the data to load in a new tab in browser could be tedious.**

# Navigating the Interface

```
import urllib
import numpy as np
import matplotlib as m
m.use('Agg') #Because I am doing this on a server with no video drivers
import matplotlib.pyplot as plt

urlObject = urllib.urlopen('https://storm.pps.eosdis.nasa.gov/storm'+
            '/OpenSSPAPI?email=matthew.r.lammers@nasa.gov'+
            '&frequency=089.062GHz&size=p-40/all&text=true')
"""Looking at the relationship between maximum dimension and
            scattering/absorption efficiency."""
osspArray = np.loadtxt(urlObject,comments='#', unpack=True,
            skiprows=2, usecols(4,8,9))

plt.plot(osspArray[0], osspArray[1], 'ro', label='Scattering Efficiency')
plt.plot(osspArray[0], osspArray[2], 'bo', label='Extinction Efficiency')
plt.legend()
plt.xlabel('Maximum Dimension[um]')
plt.ylabel('Efficiency')
plt.savefig('ScattAbs.png')
```




**Here is an example of how the OpenSSP API can be utilized without the Query Builder interface. I used Python to grab data from the API in tsv format, parsed it using the NumPy library, and then generated a basic plot using Matplotlib.**

# Navigating the Interface

**LIVE DEMO…**